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Full Length Research Paper

Prevalence of malaria among pregnant women who sleep under insecticide treated nets in Abakaliki: A retrospective study

Okpua Nelson Chidinma[1*], Uduituma Sandra Oluch[2]

[1] Department of Nursing Science, Ebonyi State University, Abakaliki, Nigeria

[2] Department of Microbiology, Federal University Ndufu-Alike Ikwo, Nigeria

[*]Corresponding Author's Email: nelson4_christ@yahoo.com

ABSTRACT

Virtually everyone, except 3% of people in Nigeria, is at high risk of malaria infection. This risk is further increased by various factors, including pregnancy. Specific interventions aimed at controlling malaria infection has proven to be ineffective as the disease has continued to rise. This study retrospectively explored the prevalence of malaria among pregnant women who used insecticide treated nets in Abakaliki. Method: Medical records of pregnant women who attended antenatal clinics and were documented to have used insecticide treated nets from 2012 to 2017, at Mile 4 hospital Abakaliki, were retrieved. Data was analysed using frequency tables, percentages and Revman 5.3 statistical software. Result: Out of 2826 pregnant women who attended antenatal visits within the period of this study, only 425(15%) were reported to have used insecticide treated nets. Their mean age was 43.4, while majority 284 (66.8%) were within the age of 17 and 30 years. 313(73.6%) of those reported to have used ITNs were diagnosed of malaria during the course of the pregnancy. This was higher 219 (77.1%) among women aged 17 to 30 years but decreased slightly as the women advanced in age. Parity was inversely associated with the risk for malaria infection in pregnancy ($P<0.001$). Women who had one to two pregnancies suffered more malaria infection (89.2%) compared to other women of higher parities. Conclusion: The prevalence of malaria infection among pregnant women who use insecticide treated bed nets is high. Studies are needed to determine their knowledge on the principles of proper use of insecticide treated bed nets; and to ascertain the relationship between time spent outside bed nets at night and the prevalence of malaria infection.

Keywords: Malaria, pregnancy, infection, insecticide, neonatal mortality, chemotherapy.

INTRODUCTION

Virtually everyone, except 3% of people in Nigeria, is at high risk of malaria infection (Nigeria malaria Indicator survey, 2010). Malaria is one of the most challenging infectious disease to eradicate in Africa, accounting for 40% of public health expenditure, 30% to 50% of inpatient hospital admissions and nearly 50% outpatient visits in endemic regions (Juliana and Nawal, 2009).

Although malaria is a threat to all, pregnant women are more susceptible to the disease and its related complications; perhaps, due to their physiological state (Juliana and Nawal 2009). According to Alo et al., (2014), the prevalence of malaria in pregnancy is as high as 79.5 percent. This fact has been further supported by 55.5% and 54.5% prevalence reported in Abuja and Abia state respectively in some studies (Basey et al., 2007; Kalu et al., 2012). These reports suggest that more need to be done to close the gap existing within the numerous ongoing malaria control programmes.

Furthermore, according to Juliana and Nawal (2009), about 25 million pregnant women were currently at high risk of malaria; a disease that accounts for over 10,000 maternal and 200,000 neonatal deaths every year. Nevertheless, the above figures may underestimate the impact of malaria in maternal and neonatal mortality and morbidity. Recent study that

examined the causes of maternal deaths in Mozambique, revealed that 10% of maternal deaths were directly caused by malaria infection, and 13% were secondary to human immunodeficiency virus (Desai et al., 2007).

The world health organization, in an effort to prevent malaria related complications; including deaths of mothers and babies, had rolled out malaria control programmes, including raised public awareness, use of insecticide treated nets and intermittent preventive treatment (Roll back Malaria 2015). Report shows that, although these interventions have posed increasing financial burden, it has also recorded a significant success only in some regions (United States Embassy in Nigeria 2011). While some researchers have argued that focussing these malaria control interventions on the hosts and parasite without strong consideration to the environment and vectors may be a strong successes-limiting factor, others believe that reducing the time spent outside insecticide treated nets every night and further educating users on proper us may be key to eradicating malaria (Alo et al., 2012; Kalu et al., 2014).

Furthermore, while the increasing resistance to anti-malarial drugs evident in emerging strains of plasmodia has raised doubts on the efficacy of chemotherapy in malaria control, the rising incidence of the disease among insecticide treated nets users are serous public health challenge. Nevertheless, there is notably little or no studies on the prevalence of malaria among pregnant women who use ITNs in Abakaliki, an endemic region for the disease. Hence, this study tends to explore the prevalence of malaria among pregnant ITNs users in Abakaliki as a way of understanding the usefulness of ITNs in malaria prevention.

Malaria

Malaria is a preventable parasitic infection commonly caused by four specific species of plasmodium that infect human; *P. ovale, P. malaria, P. vivax and P. falciparum* (Kyu et al., 2013). Children, pregnant women, travellers to malaria endemic areas, and persons with co-existing HIV infections are at highest risk for malaria-related mortality and morbidity.

According to WHO (2016), malaria infection during pregnancy is a significant public health challenge with obvious risks for pregnant women, foetus, and new-born children. Pregnant women are 3 times more likely to suffer from severe malaria infection compared to their non-pregnant counterparts, and with a mortality rate of about 50 percent. In malaria endemic areas, at least 25% of pregnant women are infected with malaria, with highest risk of infection and morbidities in primigravidas, adolescents and those co-infected with HIV or Tuberculosis (Juliana and Nawal 2009). The second trimester brings the highest rate of infection; hence WHO's policy for intermittent prophylactic treatment (IPT) using ACT for all pregnant women in endemic regions during 2nd trimester of antenatal care as part of malaria prevention and treatment. Similarly, Garner and Gulmezoglu, (2006) believes that the immunocompromised state of pregnancy and placental sequestration of infected erythrocytes are the major cause of high vulnerability of pregnant women to severe malaria.

Furthermore, malaria infection during pregnancy often results to maternal illness, spontaneous abortion, stillbirth, pre-maturity and low birth weight, especially in *P. falciparum* infection. However, in malaria high transmission regions, the level of acquired immunity tend to be higher, thus, the disease is usually asymptomatic during pregnancy. Yet parasites may be present in placenta and contributes to maternal anaemia even without peripheral parasitaemia. Contrarily, in low transmission settings, women of reproductive age have relatively low acquired immunity to malaria. In such regions, malaria often affect all pregnant women, regardless of their parity.

On the other hand, Insecticide treated nets (ITNs) are synthetic pyrethroid insecticides dip-treated nets whose protection by killing and repelling insects, especially mosquitoes are doubled using deltamethrin or permethrin. However, the efficacy of these chemicals only lasts for six months, therefore, requires bed net users to re-treat periodically.

However, Raphael et al., (2007) had reported that the efficacy of Insecticide treated nets (ITNs) has been compromised by emerging high pyrethoid resistant plasmodium strains in some regions. It is further suggested that, the efficacy of insecticide treated nets in malarial control is influenced by many factors, including the distribution, knowledge and utilization of the material (Abebe et al., 2016). This in addition, is directly rooted in socio-cultural values a region holds about mosquitoes and nets. Nevertheless, Bayoh et al., (2014) have reported that the efficacy of ITN is threatened by the development of physiological and behavioural resistance in the malaria vectors. According to the report, although the evidence that such resistance is compromising the efficacy of ITNs is limited, the physiological resistance to pyrethoid insecticides used in ITNs is widely documented. This simply implies that although ITNs are effective in preventing malaria because many malarias vectors feed late at night while people are asleep, however, it does not protect against some species of mosquitoes which bite during late evening or early morning when people are yet to go into bed nets or awoken from it. This stands a major challenge as most people spend more time outside the bed net at night before bed.

MATERIAL AND METHODS

Retrospective quantitative research design was used for this study. According to Patrick (2007), quantitative survey validates or invalidates observations made during the qualitative phase. The sample population comprised all the 425 pregnant women whose medical record were accessible to had attended antenatal clinic at mile four hospital Abakaliki within January 2012 to December 2017, and whose records show that they had used insecticide treated net consistently during pregnancy. In addition, only individuals whose record showed that they were screened for malaria infection at least once during antenatal visits were included in the study. Participants without clear record of using insecticide treated nets or malaria screening were excluded.

Consecutive sampling was used to collect data in this study. Consecutive sampling was considered the best of all non-ransom sampling technique, as it tries to include all accessible and consenting subjects as part of the sample population (Kathleen, 2014). According to Frerich (2008), such wide coverage of the population of interest reduces the risk of missing potential insights from members that are not included. Out of 2826 medical records of potential participants that were initially retrieved, only 425 (see Figure 1) records of participants met the inclusion criteria were analysed. The researcher used validated objectives-focussed data templates to gather the required data was analysed using frequency tables, percentages and Revman 5.3 statical software, and with type 1 error or strength of evidence against null hypothesis (p-value) considered statistically significant at p-value ≤ 0.05.

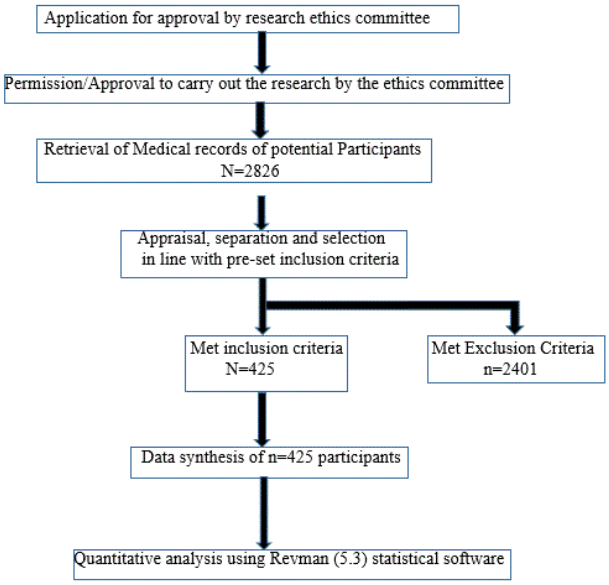

Figure 1. Sample selection flow.

RESULTS

Out of the 2826 medical records retrieved, only 425 participants were identified to have used insecticide treated bed nets during pregnancy were analysed (Figure 1). The mean age of participants is 43.4 years. Majority 284 (66.8%) were within the age of 17 and 30 years, while only 3 (0.71%) subjects were within the age of 57-69 years (Table 1).

Table 1. Prevalence of malaria in pregnancy among Insecticide treated nets users.

Age	Participants	Malaria in Pregnancy	Malaria in Pregnancy
(Years)	(N)	(Positive)	(Negative)
17-30	284	219 (77.1%)	65 (28.9%)
31-43	109	71 (65.1%)	38 (34.9%)
44-56	29	22 (75.9%)	07 (24.9%)
57-69	3	01 (33.3%)	02 (66.7%)
Total	425	313 (73.6%)	112 (26.4%)

Among the reported 425 ITNs users, majority 313 (73.6%) were diagnosed with malaria infection during antenatal care visits. Only 112 (26.4%) did not suffer from malaria infection throughout their gestational periods. Majority of those who suffered malaria infection were within 17 to 30 years 219 (77.1%). Malaria infection decreased along with age, except among the age group 44-56 years (Table 1).

The relationship between malaria infection and the number of pregnancies is shown in Table 2. The result shows that among the women studied, 166 (39.1%) have had between 1 to 2 pregnancies, 107 (25.2%) 3-4 pregnancies, 64 (15.1%) 5-6 pregnancies, and 88 (20.7%) have had 7 or more pregnancies. women with 1 to 2 pregnancies had higher rate of malaria infection 148 (89.2%) than others. Similarly, women with 7 or more pregnancies also had higher rate of malaria infection compared to women who have had between 3 to 6 pregnancies.

Table 2. Relationship between malaria infection and number of pregnancies.

Number of pregnancies	Population	Malaria Infection Status	Malaria Infection Status
(Np)	(N)	(Positive)	(Negative)
01-Feb	166 (39.1%)	148 (89.2%)	18(10.8%)
03-Apr	107 (25.2%)	59(55.1%)	48(44.9%)
05-Jun	64 (15.1%)	32(50%)	32(50%)

7 above	88(20.7%)	74(84.1%)	14(15.9%)
Total	425	313(73.6%)	112(26.4%)

From the findings, prim-gravidas are more prone to malaria infection when compared to multiparas. However, women with pregnancies between 3 and 6 seem to be more immune to malaria infection in the groups studied. Majority of the subjects studied were multigravidas 279 (65.6%) compared to primigravidas 146 (34.4%). Immunity against malaria infection was seen to increase after 1 to 2 pregnancies and declines after about 7 pregnancies (Table 2).

DISCUSSION

Firstly, out of 2826 pregnant women studied, only 425 (15%) women were documented to be sleeping inside insecticide treated bed nets. This may imply that pregnant women in the area studied may be under-utilising insecticide treated nets (ITNs) as a strategy for malaria control. Insecticide treated nets (ITNs) has been reported as powerful tools in malaria control, however, evidence show that many people do not use it for various reasons, including its discomforts (Kiwuwa and Mufubenga, 2008). Similarly, in Rwanda, study show that only 33% among 88% of Rwandan women attending antenatal clinic uses insecticide treated bed nets (ITNs) during pregnancy (Kiwuwa and Mufubenga, 2008). This explains the need for intensified awareness campaign on the importance of ITNs use during pregnancy in African and other malaria endemic regions.

Insecticide treated nets (ITNs) are synthetic pyrethroid insecticides dip-treated nets which protects users by killing and repelling insects, including mosquitoes. Apart from pyrethroids, bed nets are also commonly made safe against insects using deltamethrin or permethrin. However, the lifespan of these chemicals on the nets is six months and requires bed net users to re-treat them every six months to maintain its anti-mosquitoes efficiency (Jenny, Jo and Mark, 2006). Although evidence show that ITNs are effective in malaria control, Bayoh et al., (2014) argues that they are only effective in controlling those species of mosquitoes that feed late at night, and not those that bite during late evening or early morning when people are yet to go into or awoken from bed nets. Little or no evidence contradicts this report as most people spend more time outside the bed net at night. Similarly, Raphael et al., (2007), revealed that the efficacy of Insecticide treated nets (ITNs) has been compromised by emerging high pyrethoid resistant plasmodium strains in some regions. This, according to Abebe et al., (2016), is further threatened by various factors including; the socio-cultural values a region holds about mosquitoes and nets, the distribution, knowledge and utilization of the malaria control tool.

On the other hand, the commonly used and widely available insecticides for bet nets; pyrethroid, deltamethrin and permethrin have been reported as potentially toxic, especially when in long term use (Biondi et al., 2015). A study carried out in Gambia to determine the efficiency of permethrin treated bed nets revealed a significant reduction in rate and fatalities of cerebral malaria (Ebere et al., 2006). However, available evidence show that permethrin insecticides is a neuro-poisonous chemical which can cause itching, headache, burning sensation and cancer on exposed human skins (Ebere et al., 2006). Similarly, parathyroids and Deltamethrin insecticide, chemicals that are also efficacious in malaria control, have been reported with long-term effects; particularly skin cancer, neurodevelopmental effects, long-term neurological dysfunction, neurotoxicity, neurobehavioral disorders at lower-exposure concentrations, and poor reproductive outcomes (Sinha et al., 2004). However, clear evidence is yet to emerge on the effect of parathyroids and Deltamethrin insecticide nets on the growing foetus. Considering these side effects, alternative insecticides that are environmentally friendly, efficacious, and non-toxic to humans are required. Unfortunately, such suitable alternatives are yet to be discovered.

Secondly, this study found that majority (73.6%) of pregnant women who slept inside insecticide treated nets had malaria infection (Table 1). This could be explained by various factors. First, the increasing mosquitoes' resistance to pyrethoid insecticides has been well documented. Pyrethoid insecticide treated nets are meant to repel mosquitoes and other insects. However, studies have continued to report that some species of mosquito have developed high resistance to insecticide treated nets (Raphael et al., 2007; Abebe et al., 2016). Secondly, the efficacy of insecticide treated nets is also influence by knowledge of proper use. It has been documented that high number of pregnant women do not use the item properly. This may be due to poor knowledge on the principles of application of ITNs. Nonetheless, the time insecticide treated nets users spend outside the bed nets before going to bed is also a challenging factor. According to Garner and Gulmezoglu (2006), some species of mosquito feed on blood meals in the early hours of night and morning when users of ITNs are yet to go to bed or may have woken for early morning chores. Garner and Gulmezoglu (2006), further argued that most people spend more time at night listening to news and other activities than they spend sleeping probably inside the insecticide treated nets. This however, reduces the efficacy of ITNs as the individuals are bitten by mosquitoes daily outside their ITNs. Therefore, to avoid

malaria vectors in endemic regions could be very frustrating.

Furthermore, pregnancy come with certain physiological changes, which tend to lower mothers' immunity against certain diseases, including malaria. According to WHO (2016), pregnant women are 3 times more likely to suffer from severe malaria infection compared to their non-pregnant counterparts, justifying that pregnancy associated changes may have contributed to the high prevalence of malaria in pregnancy found in this study.

Finally, this study found that Majority 148 (89.2%) of participants who were diagnosed positive for malaria infection were either pregnant for the first or second time (Table 2). Parity and ageing are known factors that influence the strength of our body's immune system. However, according to Juliana and Nawal (2009), individuals tend to develop acquired immunity against malaria infection after the first exposure to the parasite, which may fade with age, parity and immunodeficiency. This may explain why there is rise in prevalence of malaria among population with fewer pregnancies (one to two) and those with high number of pregnancies (7 and above), while those whose numbers of pregnancies are within the range of one to seven suffered less malaria infection due to acquired immunity against the disease (Table 2).

CONCLUSION

There is high prevalence of malaria infection among pregnant women who use insecticide treated nets in Abakaliki. In addition to increasing mosquitoes' resistance to pyrethoid insecticides, Age and parity affect the immune system which consequently increases pregnant women's risk for malaria infection.

RECOMMENDATIONS

To attain a malaria free generation, a multi-dimensional approach is needed. Various malaria interventions had often focussed on the hosts and parasite without strong consideration to the environment and vectors, which form the aetiological basis of the disease. Interventions to tackle the environment and vector as the basis of malaria control will make a huge success. Problems of poor sanitation and drainage, housing and water supply, unhealthy cultures, education, poverty and inadequate social support, including access to health care facilities are major challenges in war against malaria. Therefore, solution requires socio-political, education and legislative approaches. Above all, researches should form vital tools in the fight against malaria.

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